INTRODUCTION TO MCTL PART II

INTRODUCTION TO MCTL PART II

A. CONTEXT AND BACKGROUND

Before the demise of the Soviet Union, the proliferation of nuclear, biological, and chemical weapons was considered in the context of superpower relations. The breakup of the Soviet Union and the subsequent events have had many consequences. Regional conflicts, once constrained, are now increasingly likely to result in the use of weapons of mass destruction. Opportunities to acquire key technologies and components have expanded through the dual stimuli of underutilized technical expertise and difficult economic circumstances. Simultaneously, development and availability of applicable technologies have expanded.

Responsible states have endeavored to stem proliferation of WMD through international agreements and export controls. Such tools, while imperfect, remain the basis for increasingly comprehensive steps to address the broad WMD threat. United Nations' inspectors in Iraq discovered that Saddam Hussein, in spite of international treaties, had efforts underway to develop nuclear, biological, and chemical weapons and the means to deliver them. North Korea developed the infrastructure to produce nuclear weapons even though it was a party to the Nuclear Nonproliferation Treaty. South Africa produced six nuclear devices while under the constraints of an international trade embargo. The Aum Shinrikyo cult killed and injured people in Japan by placing containers of the nerve agent sarin in crowded Tokyo subway trains. The same group had a very capable laboratory including fermentors, dryers, and sizing equipment and had produced the biological pathogen anthrax.

Concern about the proliferation of nuclear, biological, and chemical weapons and their means of delivery has reached exceptional levels. On November 14, 1994, the President of the United States found that "...the proliferation of nuclear, biological, and chemical weapons ('weapons of mass destruction') and of the means of delivering such weapons, constitutes an unusual and extraordinary threat to the national security, foreign policy, and economy of the United States...." He declared a national emergency to deal with the threat. This executive order (12938) was extended on November 8, 1995; November 12, 1996; and again on November 12, 1997.

B. OBJECTIVE

This document identifies technologies and technology levels required for the development, integration, or employment of nuclear (including radiological), biological, and chemical weapons and their means of delivery. Technologies describing the effects of the employment of these weapons and technologies for information systems required for many employment options for WMD are also included. Emphasis is placed on a proliferant country's ability to threaten the United States and its allies; however, subnational activities are also considered. Of greatest interest are technological capabilities "sufficient" to produce WMD of a given type and the ability to deliver them. Commercial-off-the-shelf (COTS) technologies can be used in many cases to obtain capability without extensive, development programs. Other technologies of concern are those that are built on the grid of existing technologies such as commercial networking of communications.

The above criteria differ from those used in MCTL, Part I, "Weapons Systems Technologies," where the performance levels of interest were those that ensure the superiority of U.S. military systems. In Part II WMD, operational technology capabilities are stressed without making any assumptions regarding an adversary's strategy or tactics, intentions, objectives, methods of employment, or target selection.

Items of proliferation concern that are on export control lists as well as those that do not appear on export control lists are included to provide indicators of possible capabilities for WMD development and to inform U.S. export control decision makers. Foreign Technology Assessments are provided to assist in understanding the capabilities of selected foreign countries in WMD-related technologies.

While every effort was made to prepare a comprehensive listing of technologies of proliferation concern, the absence of a technology should not be construed to mean that the technology could not make a contribution to proliferation.

C. OVERVIEW

This document identifies and discusses the technologies required for the development, integration, or employment of nuclear, chemical, and biological weapons and their means of delivery. Since the United States has forsworn the use of biological and chemical weapons, the underlying technologies include those usable by another country to develop an offensive capability and those needed to defend against their use. The parameters listed indicate those levels agreed to in the MCTL Technology Working Group process. They provide a description of technologies which are appropriate for possible actions by those assigned responsibility to constrain proliferation.

The technologies treated in this volume differ greatly. The development of nuclear weapons generally requires significant infrastructure, including a large capital investment required for the production of special nuclear material. By contrast, pathogenic biological agents can be made in small commercial facilities which are difficult to distinguish from legitimate pharmaceutical or related production activities. Technologies required to produce toxic chemicals are widely available, and much of the equipment is embedded in legitimate chemical industry. The infrastructure complexity and expense associated with different means of delivery vary widely. Proliferant states which have been prominent in world affairs have opted for extended investment in means of delivery, command and control, and their associated infrastructures. While not all proliferants follow such a path, there are very real reasons for doing so when the world is viewed through the eyes of the individual proliferants.

Nuclear technologies receive wide publicity. Technical information is available in the public sector at an increasingly fine level of detail. Technologies for the production and operation of means of delivery are also well known. Examples of items include the widely distributed cruise missile systems and use of the U.S.-deployed Global Positioning System, which offers users precise time and location worldwide. Biotechnologies which can be applied to biological weaponry are predominantly dual use, growing rapidly and requiring relatively small amounts of capital investment.

Heightened interest in the proliferation of WMD and their means of delivery has been accompanied by a significant amount of misinformation. Factual and carefully considered technical information is needed to address constraints effectively through nonproliferation and counterproliferation initiatives. This report provides technical data on WMD. In addition, it distills, from a technological viewpoint, reality from the myths of nuclear, biological, and chemical weapons and their means of delivery. It is helpful to retain an ongoing awareness that the problem is complex and the challenge is often driven by unique cultural considerations.

WMD warfare involves a myriad of factors: types of weapons; delivery systems; conflict arena size and WMD launch-to-target distance; attack size, timing, tactics, frequency, and duration; military or political, counterforce or countervalue attack objectives; weapon stockpile sizes; and custody and release policies and procedures.

In summary, development, integration, and employment of Weapons of Mass Destruction and their means of delivery is grounded in a huge number of choices which will be driven overwhelmingly by the political aims, culture, and resources of the proliferator. Other drivers include economics, a trained workforce, and available technical knowledge.

1. Means of Delivery

The Means of Delivery (MOD) treated here are exceptionally diverse. Included are manned and unmanned aerial vehicles of various levels of cost and sophistication. Artillery systems and multiple launch rocket systems make up the ground-based elements of MOD. These last two are traditional weapons of war, widely available and relatively inexpensive. By contrast, intercontinental ballistic missiles are complex, difficult to develop, and very expensive to maintain in operational status. Of particular interest in this section is the compatibility of the MOD with the actual payload. Physical parameters of speed, heat, shock, and delivery angle tend to drive the survivability, dispersion, and efficiency of chemical or biological payloads. In each MOD system, application of all of the technologies known to or used by the United States is not required. A proliferator has the latitude to select among often disparate, but equally satisfactory choices of means of delivery. MOD usually requires some information systems, however simple, to control assets and complete missions.

2. Information Systems

Each proliferator will use information systems to some degree throughout processes appropriate to acquire and employ WMD. Technologies treated here are commonly found within the commercial information technologies available throughout the world. Selection of information systems suites is driven by the particular combination of weapons selected, cost of information systems, and culture of the individual proliferator. The impact in various kinds of employment is addressed in detail.

3. Biological Weapons

Biological organisms are easier and less expensive to produce than special nuclear material or many chemical warfare agents. The required technology is widely available, with dual-use applications in the commercial fermentation and biotechnology industries. Because data on producing biological organisms is so widely available in open literature, it is difficult for industrialized nations to withhold relevant information from potential proliferants. Most equipment needed for large-scale production of biological warfare agents is also dual use and widely available in world markets.

Biological agents must retain their potency during storage, delivery, and dissemination. When weaponized for missile, bomb, or cluster bomblet delivery, agents are weakened by the environmental stresses of heat, oxidation, and desiccation. While it is relatively difficult to develop munitions with predictable effects, it is less difficult to spread biological agents indiscriminately to cause large numbers of casualties. Standard biological agents for covert sabotage or attacks against broad-area targets are easy to produce and easy to disseminate using commercially available agricultural sprayers.

Because biological agents reproduce, a small amount can multiply into a significant threat. When disseminated, they are slow acting; microbial pathogens require incubation periods of days to weeks between infection and the appearance of symptoms.

Toxin agents are poisonous substances made from living systems or produced from synthetic analogs of naturally occurring poisons. They are covered under biological weapons technologies in this document even though they act as chemical agents.

4. Chemical Weapons

Technologies to produce chemical weapons are difficult to distinguish unambiguously from those used to manufacture commercial chemical compounds. Many technologies that benefit chemical weapon production are dual use and widely available. Legitimate commercial chemical facilities can produce chemical warfare agents. Multiple-purpose chemical plants which manufacture organo-phosphorous pesticides or flame retardants could be converted to produce nerve agents. Open literature and standard principles of chemical engineering enable proliferants to learn how to produce chemical weapons. Although some chemical agents, such as mustard gas, are simple to produce, others are produced by more complex processes involving corrosive or reactive material.

More than 100 countries have the capability to produce simple chemical weapons such as phosgene, hydrogen cyanide, and sulfur mustard. Somewhat fewer countries are able to produce nerve agents such as sarin, soman, tabun, and VX. Commercial equipment that could be used to produce chemical warfare agents is generally available.

An operational capability to use chemical weapons involves design and development of effective munitions, filling them before use, and integrating them with a delivery system. Dispersion of chemical agents is hindered by atmospheric turbulence, which increases vertical dilution and thereby reduces casualties. Dispersion is also affected by air temperature and temperature gradient.

5. Nuclear Weapons

The basic concepts of nuclear weapons are widely known. Nuclear bomb-related physics is available in unclassified publications, and experienced foreign nuclear designers could be hired to expedite a proliferant country's nuclear weapon program, which requires a large, specialized, and costly scientific-industrial base. For most countries, the biggest obstacle to developing nuclear weapons is procuring plutonium or highly enriched uranium. Because production of these nuclear materials is the most difficult and costly part of a nuclear weapon program, leakage of weapon-grade material from nuclear-capable countries is a very serious concern.

Despite wide availability of the basic design concepts, a proliferant country must have technical expertise to produce a single nuclear weapon. First-generation nuclear weapons developed by most proliferant countries would likely be designed for delivery by short-range ballistic missile (like a SCUD) or tactical aircraft. High-performance computers would not be needed to design first-generation fission weapons.

Nuclear weapons are so destructive that delivery accuracy would seldom be a problem. Nuclear weapon effects are blast, thermal, and radiation. Against human beings, blast and thermal effects are immediate; nuclear radiation effects can be immediate or delayed.

6. Nuclear Weapons Effects

Nuclear weapons effects simulation and hardening technologies have been widely employed in the United States. Other nuclear states have employed these technologies to a lesser degree. Employment of simulation technology by a proliferator is an effective means of ensuring that the desired results will be achieved while avoiding the adverse public reaction to an actual nuclear test. Although these technologies are less widely understood than the technologies for WMD, they are included to provide key elements of insight into nuclear weapons phenomena. They are presented independently because they are a highly specialized set of technologies which have been the subject of significant research and development.

D. ORGANIZATION OF PART II

Weapons of Mass Destruction include nuclear, chemical, and biological weapons; means of delivery; information systems that enable a proliferant to command, control, and manage resources required for a WMD program; and certain nuclear weapons effects technologies that provide insight into nuclear weapons, their applications, and constructing defenses appropriate to these effects.

Each of the six sections contains the following parts:

- **Scope** identifies the technology groups covered in the section; each group is covered by a separate subsection.
- **Background** provides historical perspective and/or complementary information about the section's technologies.
- **Overview** discusses the technology groups identified under "Scope."
- **Rationale** indicates why the technology groups are important.
- **Foreign Technology Assessment (FTA),** with accompanying figure, provides summary estimates of foreign capabilities; these estimates are expert judgment by the TWGs and are discussed in Section E below.

There is a subsection for each technology group identified under scope. Each subsection contains these parts:

- **Overview** identifies and discusses technologies listed in tables that follow.
- **Rationale** indicates why listed technologies are important to proliferators.
- **Foreign Technology Assessment (FTA)** provides comments on a more detailed technology level than in the section FTA above.
- **Tables,** which are the heart of the MCTL, present data elements related to the development, production, or employment of WMD. The principal data element is **"Sufficient Technology Level,"** which is the level of technology required for a proliferant to produce entry-level WMD, delivery systems, or other hardware, and software that are useful in WMD development,

integration, or use. The **"Export Control Reference"** column provides general reference to assist in identifying potential national and international control guidelines. This column is provided for general reference and should not be construed as a definitive determination of U.S. export control policy for these technologies. Jurisdictional determination of a specific technology and/or commodity must be made in accordance with the procedures in the ITAR and EAR. (Note: For a brief description, see Appendix F, "International Regimes.") The following references are used:

- USML: United States Munitions List
- CCL*: Commerce Control List
- NRC: Nuclear Regulatory Commission
- WA: Wassenaar Arrangement
  - Cat: category designation—CCL and WA Dual Use list
  - ML: Munitions List
- NTL: Nuclear Trigger List (Nuclear Suppliers Group)
- NDUL: Nuclear Dual Use List (Nuclear Suppliers Group)
- MTCR: Missile Technology Control Regime
- AG List: Australia Group List
- BWC: Biological Weapons Convention
- CWC: Chemical Weapons Convention

Other data are defined in Appendix B, "Explanation of Table Elements."

E. FOREIGN TECHNOLOGY ASSESSMENT

The MCTL includes estimates, called Foreign Technology Assessments (FTA), of foreign capabilities in each of the MCTL technology areas. These FTA estimates are the scientific and technological consensus of the TWG members from industry, government, and academia. Collaboration with the Intelligence Community is an essential part of the FTA determination, and selected members of the Intelligence Community are TWG members who participate regularly in the MCTL process. These MCTL FTAs are foreign capability assessments and do not constitute *findings* of foreign availability, which are the responsibility of the Department of Commerce under the Export Administration Act.

Tables containing summaries of general foreign capabilities appear in each of the six MCTL Part II sections. The technological capability level is represented by diamond icons. ♦♦♦♦ indicates capability in the technology area that exceeds the sufficient level. It does not mean that the country has capability in all of the technologies associated with that technology area. It implies a range of technologies, e.g., ♦♦♦♦ for ICBM indicates that the technological capability of a country exceeds the sufficient level of technology to develop an ICBM; it does not necessarily mean that the country has the technological sophistication of the United States in ICBMs. In a corresponding manner, ♦♦♦ indicates sufficient technology capability; ♦♦ shows some technological sophistication but less than a sufficient level; and ♦ means limited capability. (*Note: This is NOT the same as MCTL Part I, where the number of blocks was related to technologies listed in the accompanying tables "at or above the minimum level necessary to ensure continuing superior performance of U.S. military systems."*) If two or more countries have the same number of diamonds, it does not necessarily mean that their capabilities are the same. An absence of diamonds in countries of concern may indicate an absence of information, not of capability.

The diamonds indicate indigenous capability to produce or the ability to legally acquire and use those technologies. A country could obtain key items surreptitiously or through illegal acquisition, catapulting the possessed WMD capability past the lower levels of expected evolutionary development.

* CCL EAR 99: Items that are subject to the Export Administration Regulations (EAR) that are not elsewhere specified in any CCL category are designated by EAR 99.